TECHNICAL MEMORANDUM

PRELIMINARY CAP DESIGN EVALUATION
KUMMER LANDFILL
BEMIDJI, MINNESOTA

March, 1991

Submitted to:

Popham, Haik, Schnobrich & Kaufman, Ltd.
Minneapolis, Minnesota

Prepared by:

Donohue & Associates, Inc.
7200 Hemlock Lane North
Maple Grove, MN 55369

Project No. 42454

I. INTRODUCTION

Donohue conducted a review of the closure plan, specifications, and cost estimates for the Kummer Landfill located near Bemidji, Minnesota. The purpose of the review was to evaluate the design concepts, review the design cost estimates, and review related construction costs developed by a consultant working for the Minnesota Pollution Control Agency (MPCA). Donohue reviewed the costs developed by the MPCA and developed new costs relating to the project under PRP control. Donohue recently completed similar projects in Minnesota and has utilized actual construction unit costs for this type of construction. A number of private contractors were also contacted to verify unit prices.

II. DESIGN REVIEW

The design completed by the MPCA is very similar to the existing requirement in the State of Minnesota for closure of currently active solid waste facilities. However, the MPCA design incorporates additional cover for frost protection of the clay barrier layer. A section of the final cover developed by the MPCA consists of the following:

6 inches topsoil
30 inches cover soil
12 inches drainage layer
24 inches barrier layer
6 inches gas control layer
90 inches (avg.) foundation layer

The purpose of the foundation layer is to provide a solid base for the landfill cap. The requirements for the foundation layer consist of a granular material (ASTM Classification SW, SP) similar to the gas control material. Granular material of this type is often used, but such stringent properties of the material are not common. Often soils such as clays, silts, or mixtures are also used provided a stable base can be developed with the material. Therefore, the least costly material available for this task should be used. The compaction requirement for this layer of 95% Modified Proctor may also be difficult for a contractor to reach. A requirement of 90% Modified or 95% Standard Proctor would be more reasonable.

The large quantity of foundation layer used could be minimized by redesigning the final cover grades to achieve the 3% minimum grades recommended by the Solid Waste Rules. The solid waste itself could be regraded to form the base for the foundation layer rather than using foundation layer material to bring the landfill to final cover base grades. Preliminary estimates indicate that this would reduce the amount of foundation layer material by two-thirds. It would also increase the quantity of solid waste to be relocated, however the cost impact of this is small compared to the significant savings on the foundation layer material.

The gas control layer will provide a permeable outlet for gas which should rise through the landfill. The specifications for this material are suitable but this layer is considered unnecessary in the design as it consists of the same material as the foundation layer. Since the material is the same, the foundation layer could serve a dual purpose, therefore eliminating the gas control layer.

The barrier layer consists of 24 inches of clay material which, based on an MPCA borrow study, is available at sites located between 15 and 18 miles from the landfill. Actual quantities available at this borrow site are unknown, therefore it is assumed that adequate material is available. A borrow source investigation conducted in conjunction with this report indicated a suitable borrow source approximately six miles from the landfill.

The drainage layer material required for this site should be readily available, however the material may require some processing to meet the specification. The specification of drainage layer material properties is considered appropriate.

The specifications for the cover soil required for this project is the same material as the gas control and foundation layers. Generally a wide variety of soils may be used for this purpose and a less stringent specification of this material could be used. The permeability of this material appears to be quite high. A permeability contrast of at least two orders of magnitude between the cover soil and drainage layer is preferred to limit infiltration into the drainage layer and encourage lateral drainage. Rapid infiltration of surface water could increase pore pressure in the drainage layer causing a shallow slope failure above the barrier layer.

In addition, the thickness of the cover soil layer is contrary to the current MPCA requirement of only 18 inches including topsoil. The total of 36 inches of cover soil contradicts the justification in the Solid Waste Rules Statement of Need and Reasonableness (SONAR) and is based more on RCRA design concepts for hazardous wastes.

The gas venting system is quite elaborate. Consisting of many gas vents which are not interconnected, the gas may not migrate to the individual vent locations. Therefore, a series of trenches at breaks in slopes connecting the vents is recommended as it is more cost effective and is proven more efficient.

The erosion control system consist of steep downward flumes and rip rap. Donohue has developed numerous systems of erosion control utilizing drainage swales and limiting the use of steep downward flumes where erosion may cause future problems. A more detailed analysis of handling of surface water is recommended, which may eliminate the large amount of rip rap used.

III. COST ESTIMATES

Cost estimates for the MPCA design and other alternative designs with modifications of the MPCA design were determined and are presented in Tables 1, 2 and 3. A review of the cost estimates which were completed by the MPCA was conducted. In addition, Donohue has prepared cost estimates for a PRP lead project on the MPCA design concept. Also presented are costs for design and construction of the MPCA cap with simple, yet cost and performance effective modifications.

1. Alternative A - MPCA Design/MPCA Cost

The MPCA design as discussed previously consist of the following:

6 inches topsoil
30 inches cover soil
12 inches drainage layer
24 inches barrier layer
6 inches gas control layer
90 inches (avg.) foundation layer

The total construction cost of $5.9 million for the MPCA design utilizing an MPCA approved contractor was developed by the MPCA in January 1991 and is presented in Table 1.

2. Alternative B - MPCA Design/PRP Contractor

For comparison purposes, Donohue has prepared construction costs for a PRP lead construction project utilizing the MPCA design concepts. An estimated construction cost of about $4.2 million is expected in this scenario. The major differences lie in the cost of the foundation layer, the barrier layer, and cover soils. After discussing these items with independent contractors, Donohue has reduced the unit costs. Independent contractors can be quite resourceful as far as location, source of material, and price negotiation with the owner.

3. Alternative C - PRP Design (Clay)/PRP Contractor

The third alternative evaluated by Donohue includes minor modifications of the MPCA design as discussed in the previous sections, the most significant of which is the reduction of the thickness of the foundation layer. This alternative would consist of the following:

6 inches topsoil
30 inches cover soil
12 inches drainage layer
24 inches barrier layer
30 inches (avg.) foundation layer

The estimated construction cost of this alternative is about $2.8 million. Donohue would recommend eliminating the gas control layer if the properties of the foundation layer remain the same or, alternatively, alter the properties of the foundation layer to further reduce costs. The MPCA has approved designs without the gas control layer as the gas will migrate either through the waste or the foundation layer to the venting system. The cost estimate for this alternative reflects an elimination of the gas control layer and change in material properties of the foundation layer to reduce costs. It also includes a reduction in the amount of foundation layer material required and an increase in the amount of solid waste to be relocated as discussed in the design review.

The costs for Bid Item 13 increase if Donohue were to redesign the erosion control system; significant savings would be reflected in the amount of rip rap required.

4. Alternative D - PRP Design (Composite)/PRP Contractor

The fourth alternative evaluated by Donohue involves using a composite barrier layer (flexible membrane and clay) rather than the clay barrier layer. The thickness of the cover soil layer is also reduced to 12 inches which is in compliance with the Minnesota Solid Waste Rules. A section of the composite final cover consists of the following:

6 inches topsoil
12 inches cover soil
12 inches drainage layer
flexible membrane liner
12 inches clay barrier layer
30 inches (avg.) foundation layer

The cost estimate for the composite final cover system alternative is $2.6 million.

5. Alternative E - Minnesota Solid Waste Rules Design/PRP Contractor

For comparison purposes only, Table 3 was prepared which presents construction costs for a solid waste landfill cover as required by the Minnesota Solid Waste Rules. A section of the final cover consists of the following:

6 inches topsoil
12 inches cover soil
6 inches drainage layer
24 inches clay barrier layer
30 inches (avg.) foundation layer

The cost estimate for this scenario is $2.4 million.

6. Cost Summary

A comparison of construction costs for the different scenarios is shown on Tables 1, 2 and 3. Significant savings are reflected in the PRP lead projects. A summary of total construction costs is as follows:

MPCA Design/MPCA Construction	$5.9 million	Alternative A
MPCA Design/PRP Construction	$4.2 million	Alternative B
PRP-1 Design/PRP Construction	$2.8 million	Alternative C
PRP-2 Design/PRP Construction	$2.6 million	Alternative D
Minnesota Solid Waste Rules/PRP Construction	$2.4 million	Alternative E

R/P/AA0

TABLE 1

Kummer Landfill Closure
Cost Estimate
MPCA Cap

Bid Item	Item Dscrp.	Quantity	Unit	Alternative A MPCA Cap MPCA Construction Unit Cost	Alternative A MPCA Cap MPCA Construction Total Cost	Alternative B MPCA Cap PRP Construction Unit Cost	Alternative B MPCA Cap PRP Construction Total Cost
1	Mobilization	1	LS	---	58,000	---	58,000
2	Site Clearing and Grubbing	1	LS	---	8,000	---	8,000
3	Access Road	670	SY	7.37	5,000	7.37	5,000
4	Foundation Layer	391,000	CY	5.45	2,133,000	4.00	1,564,000
5	Gas Control Layer	27,500	CY	5.45	150,000	4.00	110,000
6	Barrier Layer	111,000	CY	13.35	1,482,000	7.00	777,000
7	Drainage Layer	50,500	CY	5.45	275,000	5.00	252,000
8	Cover Layer	139,500	CY	5.45	761,000	4.00	558,000
9	Topsoil	27,500	CY	12.14	334,000	8.00	220,000
10	Relocation of Existing Soil and Solid Waste	14,000	CY	3.31	46,000	2.50	35,000
11	Landscaping	1	LS	---	69,000	---	69,000
12	Relocation of Hazardous Wastes	1,000	CY	10.30	10,000	10.30	10,000
13	Erosion Control System	1	LS	---	182,000	---	100,000
14	Fencing	5,830	LF	9.86	57,000	9.86	57,000
15	Rip Rap	4,600	SY	40.51	186,000	40.51	186,000
16a	Gas Venting System	1	LS	---	55,000	---	55,000
b	Gas Barrier System	1	LS	---	121,000	---	121,000
17	Extra General Excavation	50	CY	1.77	100	1.50	75
18	Extra General Backfill	50	CY	1.53	100	1.50	75
19	Extra General Select Fill	50	CY	2.36	100	1.50	75
TOTAL					$5,932,000		$4,185,000

CY = cubic yard
LS = lump sum
SY = square yard

TABLE 2

Kummer Landfill Closure
Cost Estimate
PRP Cap

Bid Item	Item Dscrp.	Alternative C PRP-1 Cap (Clay) PRP Construction Quantity	Unit	Unit Cost	Total Cost	Alternative D PRP-2 Cap (Comp. Site) PRP Construction Quantity	Unit	Unit Cost	Total Cost
1	Mobilization	1	LS	---	58,000	1	LS	---	58,000
2	Site Clearing and Grubbing	1	LS	---	8,000	1	LS	---	8,000
3	Access Road	670	SY	7.37	5,000	670	SY	7.37	5,000
4	Foundation Layer	130,000	CY	4.00	520,000	130,000	CY	4.00	520,000
5	Gas Control Layer	27,500	CY	---	---	---	---	---	---
6	Barrier Layer	111,000	CY	7.00	777,000	55,500	CY	7.00	388,000
7	Drainage Layer	50,500	CY	5.00	252,000	50,500	CY	5.00	252,000
8	Cover Layer	139,500	CY	3.00	418,000	55,800	CY	3.00	167,000
9	Topsoil	27,500	CY	8.00	220,000	27,500	CY	8.00	220,000
10	Relocation of Existing Soil and Solid Waste	40,000	CY	2.50	100,000	40,000	CY	2.50	100,000
11	Landscaping	1	LS	---	69,000	1	LS	---	69,000
12	Relocation of Hazardous Wastes	1,000	CY	10.30	10,000	1,000	CY	10.30	10,000
13	Erosion Control System	1	LS	---	200,000	1	LS	---	200,000
14	Fencing	5,830	LF	9.86	57,000	5,830	LF	9.86	57,000
15	Rip Rap	1	LS	---	20,000	1	LS	---	20,000
16a	Gas Venting System	1	LS	---	100,000	1	LS	---	100,000
b	Gas Barrier System	1	LS	---	---	---	---	---	---
17	Extra General Excavation	50	CY	---	---	---	---	---	---

18	Extra General Backfill	50	CY	---	---	---	---	---	---
19	Extra General Select Fill	50	CY	---	---	---	---	---	---
20	Flexible Membrane	---		---	---	1,400,000	SF	0.30	420,000
TOTAL					$2,814,000				$2,594,000

TABLE 3

Kummer Landfill Closure
Cost Estimate
Minnesota Solid Waste Rules Cap

Bid Item	Item Dscrp.	Quantity	Unit	Alternative E Solid Waste Rules Cap PRP Construction Unit Cost	Total Cost
1	Mobilization	1	LS	---	58,000
2	Site Clearing and Grubbing	1	LS	---	8,000
3	Access Road	670	SY	7.37	5,000
4	Foundation Layer	130,000	CY	4.00	520,000
5	Gas Control Layer	27,500	CY	---	---
6	Barrier Layer	111,000	CY	7.00	777,000
7	Drainage Layer	25,000	CY	5.00	125,000
8	Cover Layer	55,800	CY	3.00	167,000
9	Topsoil	27,500	CY	8.00	220,000
10	Relocation of Existing Soil and Solid Waste	40,000	CY	2.50	100,000
11	Landscaping	1	LS	---	69,000
12	Relocation of Hazardous Wastes	1,000	CY	10.30	10,000
13	Erosion Control System	1	LS	---	200,000
14	Fencing	5,830	LF	9.86	57,000
15	Rip Rap	1	LS	---	20,000
16a	Gas Venting System	1	LS	---	100,000
b	Gas Barrier System	1	LS	---	---
17	Extra General Excavation	---	---	---	---
18	Extra General Backfill	---	---	---	---
19	Extra General Select Fill	---	---	---	---
TOTAL					2,436,000